

BIO AUGMENTATION WORK PLAN

Huster Substation
St. Charles, Missouri

XDD Project No. 12036

Prepared For:

AMEREN SERVICES COMPANY
1901 Chouteau Avenue
St. Louis, Missouri

Prepared By:



22 MARIN WAY
STRATHAM, NEW HAMPSHIRE 03885
TEL: (603) 778-1100
FAX: (603) 778-2121

September 2016

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FIGURES

Figure 1 BioAugmentation Injection Locations

1.0 INTRODUCTION

XDD, LLC (XDD) was retained by Ameren Services Company (Ameren) to perform pilot studies for remedial options at the Ameren Missouri's Huster Substation (site) located on Huster Road in St. Charles, Missouri. The initial pilot test applications were conducted from March 10, 2014 through March 21, 2014. Results of the first phase of pilot tests are presented in detail in the *Pilot Test Summary Report, Huster Substation, St. Charles, MO*, dated September 15, 2014.

The second phase of pilot testing was conducted from in April 2015 and expanded upon the results of the first application. Chemical oxidation was used to aggressively target larger areas of the site. In addition to the area around transformer #2, sodium permanganate (permanganate) was applied to areas along the main corridor of the substation.

The activities proposed herein include in situ bioaugmentation (ISB) injections performed during the initial pilot test applications. In addition to wells MW-11 and MW-12, up to ten, 1-inch temporary injection wells (to be installed prior to site activities) will be used to apply the ISB over a larger treatment area, expanding the reactive zone within the sand strata. The ISB approach allows for immediate and long-term treatment of any residual impacts released from the upper cohesive unit into the groundwater bearing unit.

2.0 OBJECTIVES

Concentrations of PCE and trichloroethane (TCE), a by-product of PCE, have been identified in the vicinity of transformer #2 of the substation (**Figure 1**) with lower concentrations and other degradation products of the compounds at varying depths and distances away from the transformer. The presence of the degradation products indicates that natural attenuation is occurring and served as a basis for the in-situ treatment approaches used during the pilot tests. In addition to the primary compounds of PCE and TCE, other contaminants of concern (COCs) are trans-1,2-DCE, cis-1,2-DCE, 1,1-DCE, and vinyl chloride (VC).

The primary objective of the proposed ISB application is the treatment of groundwater within the substation with identified concentrations of contaminants of concern (COCs) exceeding United States Environmental Protection Agency (USEPA) Maximum Contaminant Levels (MCLs) for groundwater as drinking water standards (see table below).

Contaminant	MCL (ug/L*)	RSL (ug/Kg**)
Tetrachloroethene (PCE)	5	160
Trichloroethene (TCE)	5	110
cis-Dichloroethene (cis-DCE)	70	1,090
Vinyl Chloride (VC)	2	
*ug/L = micrograms per liter		
**ug/Kg = micrograms per kilogram		

3.0 SCOPE OF WORK

The expanded injection area (**Figure 1**) covers approximately 8,500 square feet (ft²) and targets a vertical interval of 10 feet. Approximately 100,000 gallons of groundwater will be extracted from well MW-5, the primary interior extraction well for the groundwater containment system located at the north end of the substation. The groundwater will be stored in an above ground frac tanks with 21,000 gallon capacities, and mixed with two organic substrates; WilClear®, a sodium lactate product, and EOS®, an emulsified oil product. During re-injection, chlorinated solvent-degrading bacteria dehalococcoides – (DHC) will be mixed in-line with the amended groundwater. Similar dosing of substrates and DHC used in the initial 2014 Pilot Test will be used. Every 20,000 gallons of extracted groundwater will receive approximately 110 gallons of WilClear®, 55 gallons of EOS®, and 20 liters of DHC.

The mixture of substrates with groundwater will help to create an anaerobic environment, ideal for DHC to further promote reductive dechlorination. Sodium lactate degrades quickly and provides the DHC with an immediate food source, while EOS is a slow-release compound that adsorbs to soils and provides food for an extended period of time. The amended groundwater will be monitored for a neutral pH, dissolved oxygen (DO) less than 1 milligram per liter (mg/L), and oxidation reduction potential (ORP) values less than -5.5 millivolts (mV) to ensure the solution is anaerobic prior to re-injection.

Applying ISB on an expanded level at the site will require the installation of additional injection locations in order to achieve optimal distribution. A total of 12 injection locations, using existing wells MW-11 and MW-12 and up to 10 temporary injection locations to be installed via Geoprobe® direct-push drilling techniques, will be used to distribute the amended groundwater over the expanded treatment area, 30-40 feet below ground surface (bgs). DHC will not be injected into existing wells MW-11 and MW-12 due to the known presence of bacteria at these locations; however, the two organic substrate mixture will be injected to elevate the nutrient level after two years post amendment.

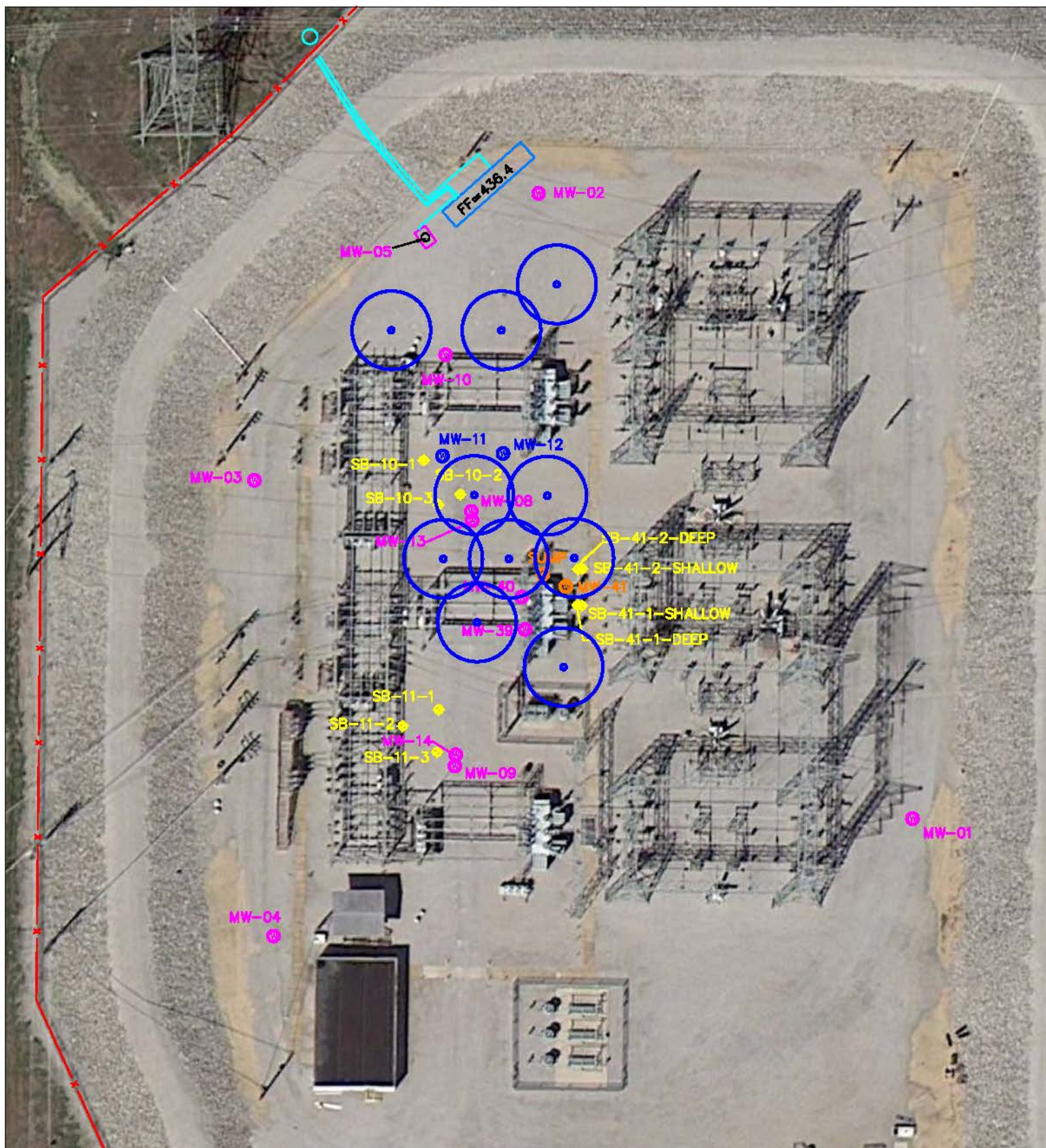
The scope of work should be completed in Fall 2016 prior to temperature drops, thereby allowing for the treatment process to occur over the winter/early spring period.

4.0 PERFORMANCE MONITORING

Performance monitoring will be conducted on a monthly basis (weather pending) following the injections. Groundwater samples will be collected and analyzed for site COCs via EPA Method 8260. With the exception of existing wells, performance monitoring samples will be collected via Geoprobe® direct push method.

The data collected from each sampling event will be used to generate plots and bar graphs in order to track trends in COC concentrations. These plots/graphs will aid in assessing the extent of COC reduction at the site. The expanded pilot test activities to address on-site impacts are expected to begin shortly after agency approval, with performance monitoring three months following injections (weather permitting). The data collected three months post-injection will be reviewed for detailed trend analysis to determine if monthly evaluations should continue or if data from the existing quarterly events is sufficient for evaluation purposes.

Figures



LEGEND:

- ⊙ MW-04 MONITORING WELL
- ⬢ SB-11-1 PHASE 1 EHC INJECTION LOCATION (IN YELLOW)
- ⊙ MW-40 PHASE 1/2 POTASSIUM PERMANGANATE (KMnO4) INJECTION LOCATION
- ⊙ MW-12 EXISTING BIOAUGMENTATION INJECTION LOCATION
- ⊙ PROPOSED BIOAUGMENTATION INJECTION LOCATION (ASSUMED 15 FT. RADIUS OF INFLUENCE)

0 25' 50'

SCALE (FEET)



SCALE: 1" = 50'

DATE: SEPTEMBER 2016

PROJECT No.: 12036

CLIENT: AMEREN

DRAWN BY: PC

CHECKED BY: DI

APPROVED BY:

TITLE:

BIOAUGMENTATION INJECTION LOCATIONS
HUSTER RD. SUBSTATION
ST. CHARLES, MO

DRAWING NO. FIGURE 1

REV.